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Devoted to the Conversion, Transmission and Distribution of Energy

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ELECTRICAL ENTERPRISES IN JAPAN.

AN ANSWER TO GIFFORD PINCHOT.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.
BY O. F. STAFFORD.

FIRE PROTECTION OF ELECTRIC PLANTS.
BY M. E. CHENEY.

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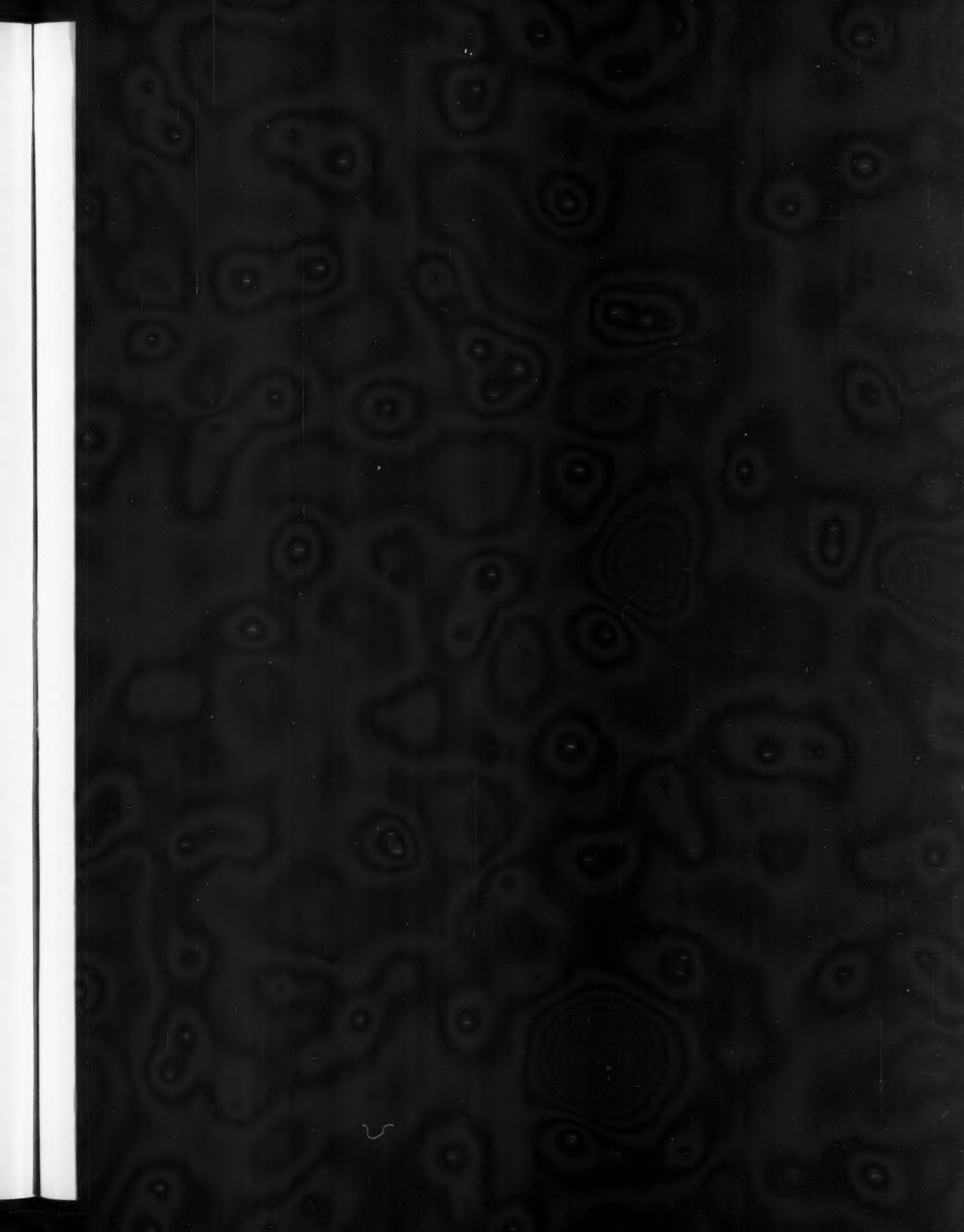

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POWER AND GAS
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ELECTRIC ENTERPRISES IN JAPAN

The first electric undertaking in Japan was only directed towards the supply of electric lights in Tokyo, by the Tokyo Electric Light Company in November, 1887, with one home-made 75-lamp dynamo (afterwards replaced by two 220-lamp Edison dynamos) installed at Nihonbashi. In the following year the company constructed three more power stations, while the Kobe Electric Light Company, installed four 20 kilowatt Edison dynamos and commenced the supply of lights in Kobe. The aggregate capacity of generating stations in Japan at the end of 1888 came to about 500 kilowatts.

In May 1889 the Osaka Light Company adopted the high tension alternating current system for the first time and opened its business in Osaka with one 30 kilowatt dynamo (1040 volts) of the Thomson-Houston type.

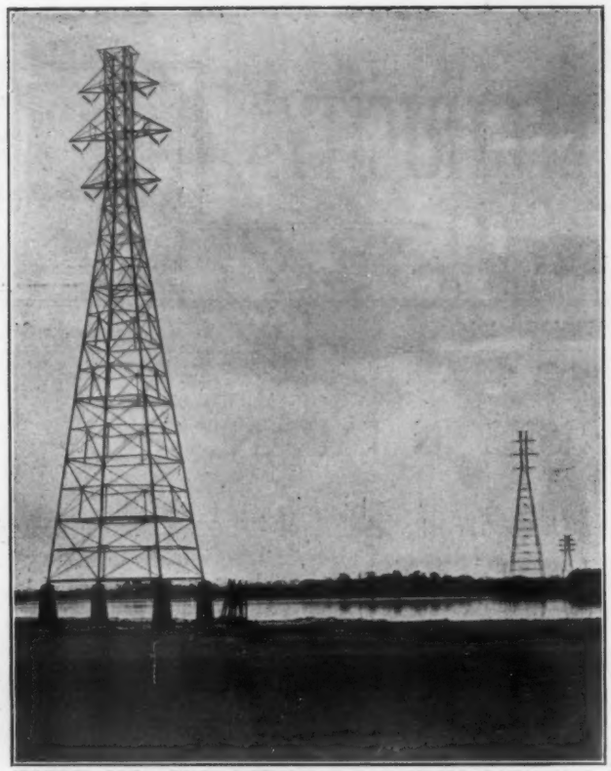
In the following year an electric light supply business was started in Kyoto, Nagoya and Yokohama, and thus the total capacity of generating stations reached 1500 kilowatts at the end of 1890.

Thereafter the electric business made a steady progress, and the first electric traction undertaking in Japan was the electric tramway which was opened in Kyoto in 1895.

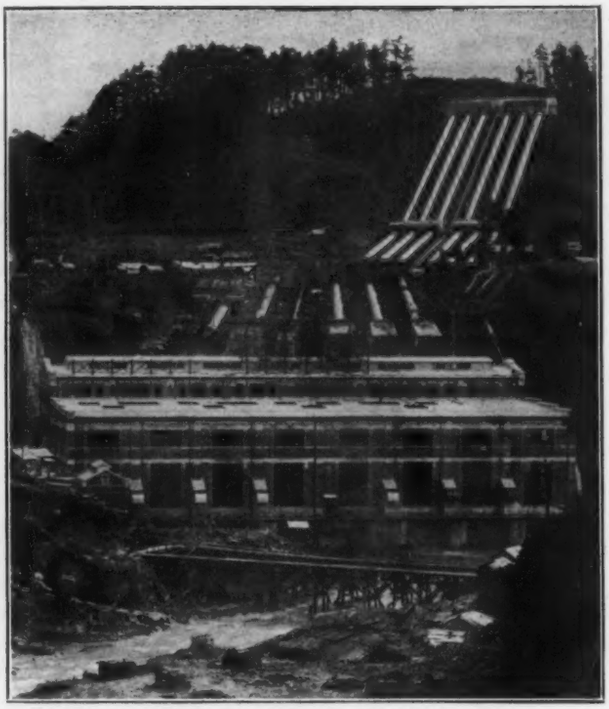
The electric undertakings in Japan continued to increase their electric power, and at the same time the method of transmitting power to a long distance was into consideration. In 1899 an enterprise was opened in the town of Koriyama for the transmission of electric power over a distance of 15 miles at a pressure of 10,000 volts, the electric capacity concerned being 300 kilowatts. This undertaking having proved a success, the voltage was further enhanced and the distance of transmission extended.

Vatsuzawa Plant of Tokyo Electric Company.

Towards the end of 1907 the Tokyo Electric Company established a hydroelectric power station at Komahashi, Yamanashi Prefecture, the capacity of which is 15,000 kilowatts, transmitting that power to Tokyo over a distance of 50 miles, to supply electric lights in Tokyo at 55,000 volts. In view of this successful undertaking of the Tokyo Electric Light Company similar undertakings have been contemplated at



Inawashiro 115,000 Volt Line, Showing 1530 ft. Span.



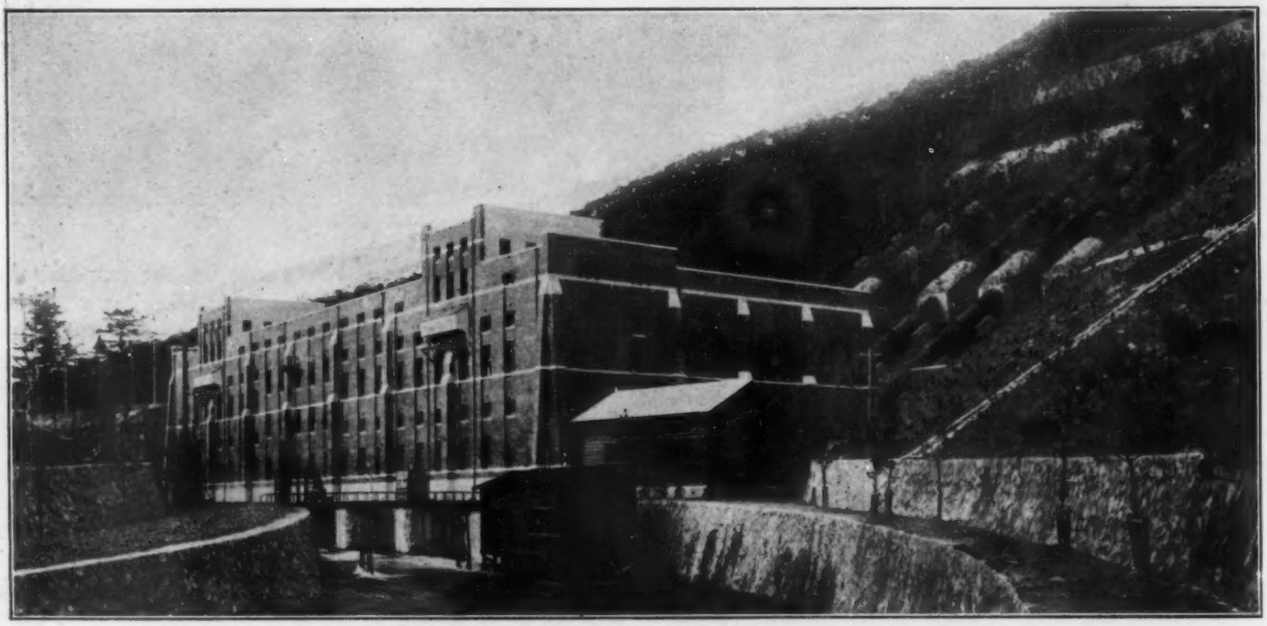
No. 1 Plant of Inawashiro Hydroelectric Company.

various places, availing themselves of the water power abundant in this country. Among those undertakings the enterprise of the Inawashiro Hydroelectric Company is the largest one ever established in Japan. In October, 1914, the company completed the work of the first hydroelectric generating station in the neighborhood of the Lake Inawashiro, the capacity of which is 14,000 kilowatts, transmitting the power to Tokyo over a distance of 140 miles at 115,000 volts.

In such circumstances electric undertakings in Japan are showing a rapidly progressive tendency; at the end of 1913 the total capacity of generating stations (exclusive of those under construction) amounted to 503,541 kilowatts; and the length of tracks of the electric traction reached 701 miles at the end of 1913, whereas it was only 72 miles at the end of 1903.

In 1910 the Hydraulic Power Investigation Bureau which was continued to 1913, was organized for the purpose of investigating hydraulic power to be utilized for generating electric power. The available hydraulic power in Japan estimated by the said bureau reached 2,205,224 horsepower.

At the end of 1914, for which period the Department of Communications has prepared the statistics which make up this article, there were 1609 electric undertakings in Japan, exclusive of Formosa, Corea,



Uji Plant of Ujigawa Hydroelectric Power Company.

Saghalin and Kwantung. Of these, 1108 were isolated plants, 339 public utility supply, 19 electric traction and 97 official plants with a total capacity of 503,541 kw. These are segregated by kind of primary power as follows:

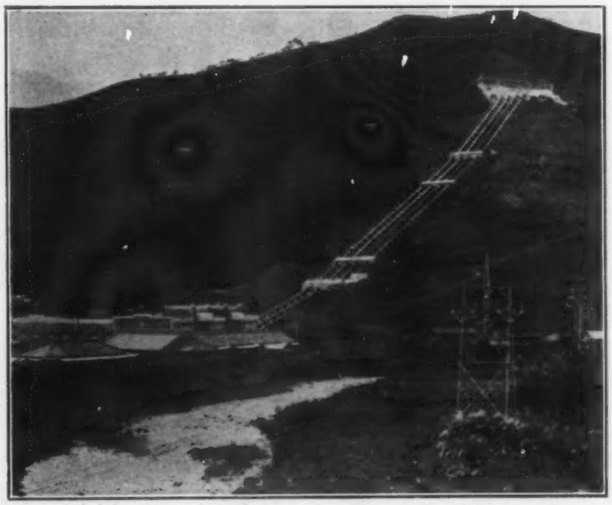
Undertakings.	Water.	Steam.	Gas.	Total.
Electric supply	213,847	53,124	6,965	273,936
Electric traction	180	3,300	.....	3,480
Electric traction & supply	28,525	59,425	434	88,384
Isolated plants	35,525	74,497	12,559	122,500
Official plants	400	14,571	270	15,241
Total	278,396	204,917	20,228	503,541

There are 247 hydroelectric plants, 130 steam plants and 117 gas engine plants, a total of 494 plants. Of 774 generators in these plants, 30 operate at 25 cycles, 226 at 50 cycles, 467 at 60 cycles, 9 at 100 cycles, 19 at 125 cycles and 23 others at various odd frequencies.

The length of transmission and number of supports is shown in the accompanying table:

Number of Electric Lines and Number of Supports.

		Extension of Lines.					Number of Supports.		
Undertakings.	Kinds.	Distance of lines. Miles.	600 volts or less. Miles.	3500 volts or less. Miles.	Over 3500 volts. Miles.	Total. Miles.	Wooden pole.	Steel tower and steel pole.	Total.
	Aerial line	11,596.0	12,863.4	23,707.3	7,662.0	44,232.7			
Electric supply.....	Underground line...	220.1	170.5	96.7	271.0	538.2	425,346	5,036	430,382
	Total	11,816.1	13,033.9	23,804.0	7,933.0	44,770.9			
	Aerial line	186.3	62.4	22.2	.....	643.6			
Electric traction.....	Underground line ..	4.5	7.5	.....	.....	7.5	12,272	1,339	13,611
	Total	190.8	628.9	22.2	.....	651.1			
	Aerial line	4,333.3	7,038.5	8,444.1	2,674.9	18,157.5			
Electric traction and supply.	Underground line...	400.4	396.1	265.1	176.3	838.3	174,406	12,314	186,720
	Total	4,733.7	7,434.6	8,710.0	2,851.2	18,995.8			
	Aerial line.....	16,115.6	20,523.3	32,173.6	10,336.9	63,033.8			
Grand total.....	Underground line...	625.0	574.1	362.6	447.3	1,384.4	612,024	18,689	630,713
	Total	16,740.6	21,097.4	32,536.2	10,784.2	64,417.8			



Shishidome Plant of Katsuragawa Electric Power Company.

The electric railway systems have 359 miles of single track and 463 miles of double track, a total of 822 miles. There are 3891 passenger cars and 396 freight cars.

There are 2,966,085 lighting consumers using 6,992,885 incandescent lamps, two-thirds of which are carbon filament. A flat rate is enjoyed by 2,903,280 of these consumers. There are also 32,033 motor users with 35,309 motors requiring 148,702 h p. and 219 consumers having 476 other appliances requiring 16,434 kw.

AN ANSWER TO GIFFORD PINCHOT.

Washington, D. C., May 1, 1916.

To the President:

Mr. Gifford Pinchot, former Chief Forester of the United States, addressed to you on January 29, 1916, a letter (which he immediately made public) urging you actively to oppose Senate Bill 3331, commonly known as the Shields Bill, relating to hydroelectric development in navigable streams. He wrote, as he declared, "in defense of the general interest" and on behalf of the National Conservation Association, a body of limited membership, not to be confused with the National Conservation Congress composed of delegates from all sections of the country which will meet in Washington tomorrow and presumably express its own views in some authoritative manner. In his letter Mr. Pinchot characterized the Shields Bill as a "threat against public warfare," as having the "great water power interests behind it," and as "astutely drawn" for such interests and in part by them.

Not content with having called your attention to these considerations, which if truthfully stated were of much gravity, he complained in a letter to newspaper editors a few days later that "feeble resistance or none at all is being made by official Washington."

Notwithstanding these characterizations and complaints, the Shields Bill, after having been reported favorably by a unanimous vote of the Committee on Interstate and Foreign Commerce, passed the Senate March 8, 1916, receiving the affirmative vote of 46 senators, against 22 in the negative. This was after a full month of open debate in which the opposition, under competent leadership, was accorded full and exhaustive hearing.

The undersigned, believing that the industry and prosperity of the country will be advanced thereby, respectfully urge you to throw the weight of your influence, in so far as you may deem proper, in favor of the passage of the Shields Bill, which is now in the House of Representatives, and beg to present their views, both as to the origin, meaning and effect of the Shields Bill and the justification or otherwise of the criticisms uttered by Mr. Pinchot.

The origin of the Shields Bill is in no respect doubtful. Amendment of the law relating to hydroelectric development in navigable streams has been the subject for many years of exhaustive study and consideration by committees of both houses of Congress. The National Waterways Commission five years ago made an elaborate report on the subject. The

judiciary committee of the Senate spent many months of research and study upon the legal questions involved. The House committee on interstate and foreign commerce conducted extended hearings on the subject. During each session of congress for nearly ten years, moreover, the subject has been debated, in various phases, by both houses. The result has been a thorough probing of every doubtful point. The passage of the Shields Bill by more than a two-thirds vote followed this long process and resulted from it. To charge that the Shields Bill, passed after the prolonged and open consideration above outlined, is the bill of any "interest" insults not only the Senate and Senators, but also public intelligence. The Shields Bill reflects the views of no one of the parties to this long and complex controversy. It is not even the bill of its introducer, nor of the committee which reported it. It was practically drafted by the Senate itself, in the light of long consideration and thorough knowledge. It is to be considered on its merits.

The distinguishing feature of the Shields Bill is that, unlike its predecessors, it presents a complete enactment under which hydroelectric development in navigable streams may go forward, subject to the direction and control of the government, whenever such development is physically and economically feasible. Under the present law an enabling act is required from Congress for each separate project. The Shields Bill fixes the fundamental requirements under which all such developments are to be permitted, leaving the issuance of the permit to the proper administrative department. By this means important resources hitherto locked up by the inaction of Congress are to be rendered available for the immediate and beneficial use of commerce and industry.

The bill fully safeguards every public interest developed and defined during ten years of public inquiry and discussion. No permit can be issued until the Secretary of War is satisfied, after examination, that the plans, specifications and location are such as are adapted to "a comprehensive plan for improvement of the waterway in question, for the uses of navigation, and for the full development of its water power and for other beneficial public purposes," thus insuring the uniform development of our streams so long contended for by disinterested students of our economic progress. The mere holding of permits without development and use, possibly to prevent competition, is effectively prevented by stringent requirements relating to the time for beginning and completing construction of the necessary works. The system provided by the bill for the regulation of rates, charges and service, a subject of prolonged controversy, fully recognizes the rights and duties of the states and the federal government and insures co-operation, not conflict. Compensation to the government in the form most useful to the public, namely, protecting and improving navigation, is provided in the sections of this bill dealing with locks and canals, and in the sections dealing with headwater reservoirs. The term of the permit is fixed at fifty years, and such permit must be relinquished by the holder at the end of that period if the United States, either for itself or for a subsequent permittee, determines to take over the property at its fair value, not including the value of the grant. Uniform accounting and reports covering assets, liabilities, capitalizations, cost of construction, cost of operation, etc., are provided for, with severe penalties for false entry or misrepresentations. Persistent breach of the conditions of the permit is penalized by forfeiture, and adequate means are provided for enforcing all state and federal orders, regulations and requirements.

In view of the foregoing, it seems hardly necessary to examine in detail the criticisms of Mr. Pinchot, whose assertions are contradicted by the provisions of the bill. His specific charges against the measure will, however, be briefly dealt with.

Mr. Pinchot asserts that the Shields Bill—

> **"gives the use of enormously valuable public property to the water power interests without compensation."**

If by this Mr. Pinchot means that no government tax for revenue purposes is imposed on the enterprise, he is correct. Such a tax would merely be a tax on the consumer of power, since it would be one of the elements necessarily involved in making the rates. Because this has been fully realized, the idea of raising government revenue from water power development has been abandoned by most of its early advocates. But it is wholly untrue that the Shields Bill gives the use of enormously valuable public property "without compensation."

Section 2 of the Bill, the section authorizing the permit, empowers the Secretary of War to require that the "grantee shall, to the extent necessary to preserve and improve navigation facilities at least equivalent to those existing prior to the construction of such dam, construct, in whole or in part, without expense to the United States, in connection with any such dam a lock or locks, booms, sluices, or other structures for navigation purposes, in accordance with plans, specifications, and conditions approved by the Secretary of War and made a part of such permit." A similar provision relating to a hydroelectric development already completed cost the holders of the permit approximately $2,000,000 for a canal and lock constructed and transferred to the government. It might in some cases cost a great deal more.

The same section also provides that "in case such navigation facilities shall not be made a part of such original construction * * * then, whenever the United States shall deem such navigation facilities necessary the grantee shall convey to the United States, free of cost, such of its land and its right of way and such right of passage through its dams or other structures, and permit such control of pools as may be required for such navigation facilities, and shall furnish free of cost power for the operation of the same" and also that "such grantee shall pay to the United States reasonable charges in consideration of the benefits accruing to and used by such grantee through the construction, operation, and maintenance by the United States of headwater improvements, including storage reservoirs."

Mr. Pinchot also asserts that the Shields Bill—

> **"has been so drawn as to make it practically impossible for the people to take their own water powers back into their hands."**

Section 6 of the Bill contains a clear, practicable

and effective plan for "recapture" after fifty years, the term of the permit. Under this section the United States may terminate the rights of the grantee after fifty years upon the taking over by the United States of all the property of the grantee which constitutes part of the plant and is dependent, in whole or in part, upon it for its usefulness and so acquired, or is necessary, appurtenant, valuable or serviceable in the the distribution of water or in the generation, transmission and distribution of power, and upon paying to the grantee the fair value of the property taken and assuming contracts previously made under government sanction. By a further provision of this section, the United States is permitted not only to terminate the permit and take over the property for its own use, but also for the use of a subsequent permittee.

Mr. Pinchot also asserts that the Shields Bill—

"interposes every possible legal delay between the violation of a government permit and the chance of effective enforcement."

Section 8 of the Bill imposes a fine of $1000 for every violation by a permittee of the provisions of the act, or of any of the conditions of the permit or of any lawful regulations or orders of the Secretary of War; confers special jurisdiction upon the United States District Courts summarily to enforce such provisions, conditions, regulations, and orders; and in case of persistent violation, authority is given for a decree revoking all rights and privileges granted under authority of the act.

Mr. Pinchot also asserts that the Shields Bill—

"fails to require the necessary publicity and uniformity of accounts, and so makes the effective supervision of water power corporations impossible."

Section 7 of the Bill makes provision for exactly what Mr. Pinchot asserts is lacking, in the following language:

"The Secretary of War shall have the right to provide rules and regulations for uniform accounting, to examine all books and accounts of grantees under the terms of this Act, to require them to submit statements, representations or reports, annual or special, including full information as to assets and liabilities, capitalization, cost of project, cost of operation, the production, use, transmission and sale of power. All such statements, representations, and reports shall be upon oath unless otherwise specified, and in such form and on such blanks as the Secretaries may require, and any person making any false entry, statement, representation or report under oath shall be subject to punishment as for perjury."

Mr. Pinchot also asserts that the Shields Bill—

"gives to the water power interests the right to condemn or take any land they choose."

This charge is contradicted by the provisions of subdivision two of Section 2 of this bill, requiring that the Secretary of War be first satisfied regarding the qualifications of the grantee and the appropriateness of the project before construction is begun.

Mr. Pinchot also asserts that the Shields Bill—

"forces the people, when they take back the public property whose use they have granted, to pay the unearned increment on land condemned or otherwise acquired by the grantee."

What the people "take back" upon recapture is something very different from "the public property whose use they have granted." It is the latter, together with all the plant that has been built up out of fifty years' investment of private investors.

For "the public property whose use they have granted," the people pay absolutely nothing upon recapture. In the words of the Bill: "no value shall be claimed by or allowed to the grantee for the rights hereunder granted."

But for the property acquired and built up out of the investors' own money, the United States, when it takes it over, must pay to the grantee "the fair value." To call the value accruing to this property after fifty years' investment an "unearned increment" is to stigmatize this form of investment with a term that is absolutely a misnomer. With "the rights hereunder granted" forever eliminated from the value of the property, there remains no "unearned increment" whatsoever. If what is left be indeed in any part "unearned increment," then all real estate investment, of every kind whatsover, includes "unearned increment."

When the government determines that every real estate owner must relinquish to the federal government any increase in value that accrues upon his property through his foresight, skill and energy with which he develops his investment, the government may, in the computation of "fair value" upon recapture of water power developments, fairly exclude every item of appreciation in land value. But until the government adopts this policy toward every kind of real estate ower, it would be grossly unfair and utterly discouraging to water power development to enforce this rule against investors in such developments, while it enforces no such rule against investors in other forms of real estate, even though such real estate be actually adjoining water power developments and appreciate in value solely because of such proximity.

If the United States takes over any water power development, it necessarily takes it over as it stands, as an entirety. Common honesty can, therefore, suggest no other basis of compensation than "paying to the grantee the fair value of said property," which is precisely what the Shields Bill, as passed by the Senate, provides.

This is all that is meant by paying "fair value" upon recapture.

Without unfairness to Mr. Pinchot, it is submitted that the above presentation of facts shows his assertions with reference to the Shields Bill to be incorrect and misleading.

Yours very truly,

H. W. HAND,
CALVERT TOWNLEY,
W. W. NICOLS,
CHESTER W. LARNER,
J. E. WAY,

Executive Committee Water Power Development Association.

Hon. Woodrow Wilson, President of the United States.

Trouble with CO_2 recorders usually is due to the fact that persons responsible for their operation are not thoroughly and properly instructed. Bulletin 91 of the U. S. Bureau of Mines describes tests on various makes of instruments and gives valuable suggestions in their use in furthering power plant economy.

FEASIBILITY OF ELECTROCHEMISTRY AT THE DALLES.

BY O. F. STAFFORD.

(Continued.)

Phosphate rock. This material is utilized upon an enormous scale as a constituent of commercial fertilizer. The usual method of preparing phosphate fertilizer is to grind the naturally occurring phosphate rock to a powder and treat it with sulfuric acid, whereby the phosphate content becomes more soluble and more immediately available for the use of plants. The magnitude of the phosphate industry in the United States is indicated by the fact that in 1913 over 3,000,000 tons were produced, three-fifths of which was consumed at home.

The phosphate rock industry has had its greatest development in the southeastern states of Florida, Tennessee, South Carolina, Kentucky and Arkansas. Recently, however, extensive fields of phosphate rock have been discovered in Utah, Idaho, Wyoming and Montana, it being estimated that 85 per cent of the reserve supply of phosphate rock in the United States exists in these western states.

Attempts have been made from time to time to utilize the heat of the electric furnace for the treatment of phosphate rock rather than to use the sulfuric acid which has always been made use of for this purpose. These attempts may be said to be still largely in the experimental stage, although if rumors seemingly coming from dependable sources are to be at all credited the plan to make use of the electric furnace may be looked forward to with confidence as a coming process.

Assuming that this prediction may in time be substantiated, western water powers must play an important part in the process of making the enormous stores of phosphate rock in the West available for agriculture. The rock itself is to be regarded as a heavy chemical and therefore cannot be transported long distances for treatment, so that the logical solution of the problem of phosphatic fertilizer supply in case electric furnace methods do materialize is to make use of the western water powers and carry the finished product to the market centers.

What may be at present regarded as the center of the western phosphate field lies in southeastern Idaho near the towns of Soda Springs, Georgetown and Montpelier, on the Oregon Short Line Railroad. The rock is mined by processes similar to the mining of coal where the seams are worked by means of quarries, tunnels and shafts. The average cost of mining is said to be $1.50 per ton. Haulage to the railroad by wagons varies from 50 cents to 75 cents a ton while freight from shipping point to The Dalles may be taken as $4 a ton, the distance being in round figures 800 miles. It follows, therefore, that the price of phosphate rock at the electric furnace site would be not less than $6.50 per ton, allowing the producer of the rock a profit at 50 cents.

The Electrochemical Industries.

Under this heading will be considered the industries producing the following substances: abrasives, caustic and bleach, calcium carbide, chlorates, cyanides, graphite, phosphorous compounds, nitrogen compounds.

Abrasives.

Until the advent of cheap electricity the world's supply of abrasives was practically altogether from natural sources. Certain sandstones, chosen according to the sharpness or the fineness of their sand particles, furnished a variety of grindstones and hones which were made to answer for many purposes, while emery, when crushed and sized, could be used as powder or be formed into wheels or hones useful where the needs were more exacting than would be satisfied by grindstones.

In 1891 the discovery was made that a mixture of coke and sand, when suitably heated in the electric furnace, would yield a crystalline compound of carbon and silicon which at first was thought to rival even the diamond in hardness. Later tests demonstrated that although the diamond might still retain its supremacy as the hardest of all substances nevertheless the new material was an abrasive of exceptional value. It is now manufactured both under its original trade name, carborundum, and under another trade, name, crystolon.

Raw materials are reported to be coke or anthracite, sand, sawdust and salt. It is estimated that these cost at Niagara Falls approximately $6 per ton of finished product and require for their conversion into abrasive about one and one-fifth horse-power-years of electrical energy. Other costs are not available, but assuming the cost at the furnace to be $30 per ton at the present factories and taking into account the higher cost of materials, labor and capital in the West, even though power in the East is figured at $15 per horsepower-year and in the West at $9, the advantage is with the eastern location to the extent of approximately $5 per ton.

Another abrasive has lately come into the market which is made in the electric furnace from bauxite, the crude ore of aluminum. This substance, called alundum, is fused aluminum oxide and accordingly akin chemically to natural emery, to which, however, it is much superior as an abrasive. It was estimated that in 1913 aluminum ore corresponding to 10,000 tons of metallic aluminum would be converted into alundum. Cost data regarding the manufacture of this abrasive are not available, but since the raw material necessary is more easily obtained at eastern manufacturing points than at western it is certain that a cost comparison would be unfavorable to a western location.

A peculiar market situation exists with reference to these abrasives in that they are really the raw materials for another industry, the making of wheels, hones, etc. This industry is naturally under the control of the firms producing the raw abrasives. When it is considered that much additional labor is expended in making and marketing these finished products the power costs, reckoned against the final selling prices, become relatively unimportant, a fact which further operates against the proposal to remove the industry to a point where only cheaper power may be available.

Also it is probable that 98 per cent of all abrasives made are consumed in the metal-working industries of the northeastern states, a consideration which makes the present locations of the abrasives-producing industry commandingly ideal.

It is therefore certain that an electro-chemical abrasives industry in the West would exist under a handicap both as regards production costs and transportation which would render competition with factories at an eastern site extremely difficult if not absolutely impossible.

Caustic and Bleach.

By the term "caustic" in the present case is meant the common commercial form of concentrated lye known also in the chemical trade as sodium hydroxide. This substance is in use in a large way in the arts and its manufacture represents one of the largest of the chemical industries. Its raw material is common salt. Formerly the production of lye was accomplished altogether through the intermediate manufacture of sodium carbonate, common forms of which are familiar as soda ash and sal soda. Sodium carbonate upon treatment with lime yields lye. This method is still in use and furnishes a large part of the total world's production.

With the possibility of cheap electricity an electrolytic method for the production of lye from salt directly was quickly perfected, the lye formation being simultaneously accompanied by the formation of chlorine gas, a substance which combines readily with quick lime to form bleaching powder. It is therefore obvious that the electrolytic alkali industry is inseparably connected with the "bleach" industry. The relative amounts of the two substances vary with the processes used and with other conditions, but may be taken in round numbers as five parts of lye produced for every 12 parts of bleaching powder.

The manufacture of lye alone by the electrolytic process would not be possible in competition with the lye produced by the older soda process were it not for the revenue obtained from the sale of the bleaching powder. In a sense, therefore, bleaching powder is the primary product in this industry, since the amount of this substance which can be marketed really determines the amount of lye which may be produced.

Both caustic and bleaching powder are to be considered as heavy chemicals since they are normally valued at approximately $45 and $30 per short ton respectively at factory site. They are therefore not to be manufactured at long distances from their markets. It is usually considered that the market for lye is distributed in a manner roughly proportional to the distribution of population. The consumption of bleaching powder, however, is more localized, its main use being in connection with the textile industries.

The production of electrolytic lye in the United States in 1909 is given as 22,000 tons valued at $47 per ton. The corresponding production of bleaching powder was 50,000 long tons valued at $29.50 per ton. Electrical power consumed in the industry was approximately 12,500 horsepower-years. The production of lye by the soda process in the same year is given as 125,000 tons, making about 15 per cent of the total as the production of the electrolytic plants.

All costs of producing electrolytic lye would be higher at a western plant than at an eastern, excepting the cost of power. Capital and labor costs may be taken as 15 per cent higher; lime will cost $6 in the West as against $4.50 in the East; salt will cost $6 at The Dalles as compared with $2.50 at an eastern power site; coal will cost $5 a ton as compared with $3; while power may be taken at $9 instead of $18 per horsepower-year.

Assuming a plant capable of making 4000 tons of lye and 10,000 tons of bleach per annum and having a capitalization of $300,000, the cost of producing one ton of lye and the corresponding 2½ tons of bleaching powder may be taken as $75 at the eastern point as compared with $90 at the western. The apportionment of costs against the lye and bleach respectively is obviously a matter of bookkeeping only. With lye selling at $45 and bleach at $25 per ton the income from the quantities just considered would be $107.50.

From the above analysis it follows that western made electrolytic lye and bleach can never enter the eastern market until the cost of power in the East shall advance to a point where not only the above difference in production costs is equalized, but to where the cost of transportation to the East shall be compensated as well. Assuming that freight from The Dalles to New York may sometime be such that the 3½ tons in question may be moved this distance for $15, there would then be a difference of $30 altogether for the western manufacturer to overcome by virtue of his cheaper power costs. Fixing western power at a cost of $9 per horsepower-year, and considering that one-half horsepower-year only will be consumed for the one ton of caustic and its corresponding 2½ tons of bleach, this amount of power would have to cost $30 more at the eastern factory than at the western site. In other words until the cost of power in the East, in round figures, should approach $70 per horsepower-year, the cheaper western power would not offset the general disadvantages of the western location as far as serving eastern markets might be concerned. It is needless to point out that power will not have any such value in the East for a long time to come, steam power itself being available at a much lower figure.

On the other hand, the manufacture of caustic and bleach up to the limit of construction by Pacific Coast markets should be altogether a possibility at some favorable western power site. It is estimated that the coast consumption of lye is approximately 4000 tons, or just about the amount considered in the manufacturing unit assumed above. Japan is said to have used 5000 tons of English lye in 1911 while doubtless other markets might be found which could be served more easily from the western coast than from the eastern. The disposition of the corresponding 10,000 tons of bleach is a much more doubtful matter, however, since the consumption in the Pacific Coast states is estimated to be but 5000 tons.

It would seem, therefore, that under present conditions the manufacture of electrolytic lye and bleach could not be carried along profitably upon the western coast were the output greater than approximately 2000 tons of lye and 5000 tons of bleaching powder. Such a unit would absorb practically but 1000 horsepower-years of energy.

(To be continued.)

FIRE PROTECTION OF ELECTRIC PLANTS.

BY M. E. CHENEY.

(After detailing the fire hazards of electric plants and the means of correction, specifications are given for a standard plant construction to minimize the insurance rate. Subsequent installments analyse a typical steam plant and show how its departure from standard construction affects the rates. This article is slightly abridged from a paper presented at a joint meeting of the A. I. E. E. and N. E. L. A, Sections at Portland April 11, 1916. The author is electrical engineer with the Washington Surveying and Rating Bureau of Seattle, which has jurisdiction in Washington only. Methods outlined and rules and charges for deficiencies apply only to such jurisdiction.—The Editor.)

Experience indicates that the commonest cause of extended interruption to power and light service and delay to electric car traffic, particularly in cities, is due to destruction of power plants or rolling stock by fire. The numerous recent fires in electric properties in the United States, is demanding the attention of electrical and insurance interests, and of the public in general. Not long ago in one of the electrical journals were listed no less than four power plants completely destroyed by fire.

A study of the statistics of 95 power plant fires compiled by the National Fire Protection Association reveals the surprising fact that fires resulting from the common causes outnumber those from the special hazards two to one. Of the boiler fires, which are responsible for over 25 per cent of the losses from all causes, one-third originated because of the iron stack improperly installed. Of the special hazard fires, electric wiring, either defective or by reason of crossed circuits, was productive of the greatest trouble. The preponderance of fires from common causes over those from special hazards, while indicating that the present practice of safeguarding the electrical hazards is effective, strikingly brings out the disregard of properly safeguarding the common hazards, such as heating, lighting, boiler settings, care of oily waste, and general accumulations of combustible material not necessary to the operation of the plant.

The records show that only two fires occurred in plants of fire-resistive construction. A little over one-third of the buildings were brick and wood construction.

An important fact, and one which is undoubtedly responsible for the extent of the losses, was the absence of private external or internal protection in practically all of the plants. Nearly one-half of the fires were extinguished by the help of public departments. Extinguishers where used were always reported as being satisfactory.

Several interesting features regarding the losses are brought out from the reports. Losses to buildings were either total or slight, while the losses on contents were usually heavy. These results would have been greatly modified by the existence of fire walls separating the station into individual areas, which would under normal conditions be more or less immune from fire in any other section.

Just how many of the 95 fires were preventable with ordinary care or could have been readily extinguished in their incipiency had adequate means of protection been installed can only be estimated, but careful study of their history leads one to believe that it is well above 60 per cent. These 95 fires demonstrate beyond a doubt that:

Roof coverings having good fire retardant qualities are essential to the safety of the power house.

That power houses having roofs of combustible material are always liable to serious damage, especially where remote from fire protection.

That ventilators or other roof structures of frame construction are a menace even on unexposed stations.

That power air ducts or chambers for cooling transformers, and similar construction work forming concealed spaces which may hide the presence of fire are an unnecessary fire danger.

That combustible supplies, especially waste—clean or oily—should be kept in covered enclosures of non-combustible material.

That switchboards should be so located and guarded that not only may operators manipulate control apparatus in safety but that such apparatus and boards will be susceptible to damage from disorders on the wheel or generator floor.

That quick acting valves controlling turbines should be so located in hydroelectric plants that water may be promptly cut off from points outside the zones of possible trouble.

That greater care must be exercised in the choice of capacities and types of oil switches.

That apparatus performing different functions should be segregated, that is, the switching, generating and controlling apparatus should be separated from each other.

That sand pails and extinguishers prove very effective in extinguishing fires in their incipiency.

That standpipe and hose equipment with ample water supply and pressure sufficient to produce effective fire streams are indispensable to the station with combustible roofs or floors or those containing quantities of combustible material. Particularly is this true of stations remote from public protection.

That oil transformers under normal conditions and when properly operated are not a serious fire hazard. The chief hazard lies in a severe arc near the surface of the oil or from oil escaping from the transformer case; and a serious hazard lies in drying out transformers by charcoal fires under them—particularly so when leaks develop in the case.

In fact, so many destructive fires have occurred from preventable causes both in power plants and electric traction properties that comparatively large concessions are made in insurance rates for the correction of these so-called remedial defects in building and equipment. A number of electric companies in Washington, through making improvements in their property whereby the fire hazard is reduced, aside from attaining immunity from interrupted service through fire to a marked degree, have had returned to them from ten to twenty per cent per annum on the money throughout the state, from which improvements vast benefits in a reduced fire waste would be reaped.

Insomuch as one of the functions of the Washington Surveying and Rating Bureau is to obtain a reduction in the fire waste as well as to recommend equitable insurance rates, it is in these capacities anx-

ious to co-operate with you for the mutual benefit of yourselves and the insurance companies.

To more clearly demonstrate to you the concessions made in insurance rates on power plants for standard construction and protection, and to show the methods employed in estimating a rate on such a plant, I will first run over briefly the essentials of a so-called standard plant and then rate for you a typical plant which we will construct for the purpose, pointing out the various chargeable deficiencies and showing the reduction in rate effected by correcting the remedial defects.

The Standard Plant.

In considering the ideal construction and arrangement of a power plant to reduce to a minimum possible property loss or interruption to service by fire there is one feature which stands out paramount, this is, the type of structure housing the apparatus. This should be of highest possible type of fire-proofed construction, incorporating in brief the following details:

Walls.—To be of hard-burned brick, stone or reinforced concrete, not less than 12 in. in thickness for buildings not over one-story in height, and increasing proportionately for buildings over that height. In a word, walls to be strictly in conformity with the National Board of Fire Underwriters' requirements, as given in their building code. All cut-off or division walls segregating sections of the plant to be of similar construction as the outside walls and have all openings protected by double standard automatic fire doors.

Partitions.—All to be of non-combustible material.

Roof to be constructed of non-combustible material, and have non-combustible covering or approval composition.

Roof trusses.—All metal to be insulated on the sides by not less than four inches and on the top and bottom by not less than two inches of concrete, terra cotta or other approved insulating material recommended by the Building Code of the National Board of Fire Underwriters.

Skylights.—To be of approved wired-glass in metal frames.

Floors.—Concrete, cement, iron or brick.

Stairs.—To be non-combustible.

Finish.—To have no concealed spaces.

Exterior attachments.—Building to be free from combustible cornices, porches or other exterior attachments.

Lighting.—By electricity. Wires to be installed in approved conduit in conformity with National Electrical Code.

Heat.—Steam, electric, hot water or hot air. Pipes to be free from wood work and supported on iron hangers. Electric wiring for heaters to be in conduit in conformity with the requirements of the National Electrical Code. Air ducts through division or cut-off walls or floors to be fitted with a self-releasing damper so installed as to prevent the spreading of fire through the ducts from one section of floor to another.

Fuel oil system.—To be constructed and installed in conformity with specifications of the National Board of Fire Underwriters.

Occupancy.—Generating, substation, transformer station and/or storage battery station only.

Conductors.—(a) Lead encased cable installed in metal or other approved ducts.

(b) To be properly protected by flameproof covering where grouped as behind switchboards and control panels.

(c) To be properly protected by automatic overload devices.

Switchboard.—To be of slate or marble readily accessible from all sides and so located that the attendant will have at all times a full view of moving apparatus under his control. Switching apparatus for currents in excess of 6600 volts to be operated through remote control switches. All oil switches, whether automatic or non-automatic, controlling current at a difference of potential in excess of 6600 volts to be enclosed in fireproof compartments unless such switches be of the boiler tank type.

Resistances and rheostats.—To be of an approved type, standardly installed in a location free from combustible material.

Lightning arresters.—All overhead leads entering station to be protected. Electrolytic arresters preferred. These to be located either outside the station or in a separate enclosure, cut off from the remainder of the building. All choke coils or other attachments inherent to the lightning protective equipment to have an insulation from ground or other conductors equivalent at least to the insulation specified at other points of the circuit in the station.

Transformers.—Oil transformers to be located in a fireproofed room or compartment, provided for the purpose, cut off from the remainder of the building, properly equipped with drain and ventilation. Transformers should be equipped with a quick opening valve so that oil may be drained rapidly from the case should necessity for so doing arise. The door sill to the compartment should be raised at least six inches above the floor level to insure the non-escape of oil into other sections of the building.

Air-cooled transformers.—Should be insulated as far as possible from other apparatus and supplied with air through a fire-proof duct.

Waste Cans.—Standard metal waste cans to be provided and all waste, clean or oily, kept therein.

Clothes lockers.—To be of metal of an approved type.

Oils.—Not exceeding three barrels of lubricating oils may be kept in standard cabinets or central oiling system may be used; otherwise only one day's supply should be kept in building. No kerosene, gasoline or other volatile combustible liquids to be kept on the premises.

Watchman.—If not running night and day continuously there should be an approved watch-clock and hourly records made thereon, all dials to be kept on file for inspection, provided that in areas of not over 8500 sq. ft. watchman will not be required.

Fire protection—Internal.—It has been aptly stated that all fires are of the same size when they start and that a little fire is quickly trodden out, yet, being suffered, rivers cannot quench. Ample means

for extinguishing the small blaze is a prerequisite, even in a standard plant with little combustible material. For this purpose are recommended pails of dry sand and chemical extinguishers. A rule often followed for the distribution of sand pails and extinguishers is three of the former and one of the latter to each 4000 sq. ft. of floor area. In our standard station, owing to the small amount of combustible material present, carbon tetrachloride extinguishers, such as the J. M., Justrite and Pyrene, all of which are approved by the Underwriters' Laboratories, are recommended. Owing also to the small amount of combustible material present and the type of construction of our standard station other protection of either a private or public character is not deemed a necessity.

Exposures.—However well our station is constructed, however well all openings in our walls are protected, with wired glass in metal frames or with shutters, care should be exercised to prevent the erection of frame, or other combustible buildings, within a radius of at least 20 ft. With such a standard plant, standardly maintained, little anxiety need to be felt as to interruption of service because of fire within the plant. In fact, such plants have even withstood the ravages of conflagrations which spread through and destroyed other structures. A recent notable example of this is the Salem Gas & Electric Company's generating station, which passed without serious damage through the great Salem conflagration.

Insurance Rating.

While the standard plant is the ideal and the end to be desired, unfortunately few of these plants exist, the greater number being of vastly inferior construction, many wholly or in part of frame or corrugated iron on wood supports or other equally combustible material.

The rate-maker must, however, be equipped to place an adequate and just rate on any type of building or installation under any or all conditions or combination of conditions that may obtain and he has as a key for estimating the fire hazards of such stations a schedule which names not only a basic rate or starting point for a particular type of station but also the charges to be added to the basis for the various deviations from the standards of construction and installation. Schedules are arranged by committees of experts and over a number of years are a reflection of the experience of insurance companies on the particular class of risk to which the schedule applies.

Along with the rate-maker comes the protection engineer, who, after an exhaustive survey of a particular plant, makes recommendations for relieving the fire hazard in the plant. Compliance with his recommendations immediately is reflected in the insurance rate on such property.

The one inflexible law of rate-making is "The premium income must be commensurate with the hazard." Hence it naturally follows that a reduction of the hazard justifies a reduction in the premium rate. The operation of the schedule and routine followed by the rate-maker as well as by the protection engineer is best shown by an application of the schedule to the following typical steam plant.

[To be continued.]

LETTERS TO THE EDITOR.

A Foredoomed Experiment.

Sir:—My attention has been drawn to an editorial entitled "A Foredoomed Experiment," appearing in your issue of May 13, 1916, and referring to the recent decisions of the railroad commission in the San Joaquin Light & Power Corporation and Mt. Whitney Power & Electric Company cases.

This editorial is incorrect in its statements of fact in a number of important respects and unless corrected may do serious injury to these utilities in their future financing as well as work an injustice to the railroad commission. I am certain that you would not intentionally misstate the facts and accordingly ask, in justice both to these utilities and to the railroad commission, that you publish this letter in your next issue.

You are, I assume, aware that the railroad commission, acting in accordance with a formal request from each of these utilities, established **all** the rates, rules, regulations and contracts to be henceforth charged and observed by them in connection with **each** class of service rendered by them.

As your statements are limited to those portions of the railroad commission's decisions which refer to the agricultural power business of these utilities, I shall confine myself to this class of business.

Preliminarily, I desire to call attention to the fact that the entire agricultural power business of the San Joaquin Light & Power Corporation, in terms of connected load, is but 14.1 per cent of the total load served by this utility. Of this 14.1 per cent not more than 52.5 per cent was supplied during 1915 at the $50 per horsepower per year rate. The agricultural power business of the Mt. Whitney Power & Electric Company in 1915, after it had acquired the properties and business of the Tulare County Power Company, was approximately 56.25 per cent of its entire connected load and only about 48 per cent of this agricultural business was supplied under the annual rate of $50 per horsepower per year.

1. The statement in your editorial that "both the San Joaquin Light & Power Corporation and the Mt. Whitney had been serving irrigation consumers at a flat rate of $50 per horsepower per year," may be misleading in that it does not draw attention to the fact that each of these companies had other flat and meter rates for agricultural power, considerably lower than the annual rate of $50 per horsepower per year.

2. The statement that "in each case the commission has not only reduced this rate to $42.30, but has given an alternative monthly graded rate whereby a farmer may have seven months' service for $29.75" is inaccurate. The $50 rate was on the basis of maximum demand while the $42.30 rate is on the basis of connected load. Speaking in each case in terms of connected load, the reduction was from $47 to $42.30 in the annual rate, and from $37.84 to $29.75 for the seven months' rate.

3. The statement that "as seven months is the average period for irrigation pumping in the San Joaquin Valley, the new rate represents a reduction of

virtually forty per cent in the income per horsepower of installed capacity from such irrigation consumers," is misleading both because the average period for irrigation pumping in the San Joaquin Valley is in excess of seven months and because each of these utilities already handled a considerable portion of their agricultural pumping business under seasonal rates considerably cheaper than the twelve months' rate of $50 per horsepower.

4. The statement that "coupled with this tremendous reduction in rate, the consumer may secure service without signing a contract or without giving any guarantee that bills will be paid, such as was formerly secured by a lien on the land," is contrary to the facts in three particulars. First—no tremendous reduction has been made in the rates; second—contracts are expressly permitted in the first instance for agricultural power business under the commission's decision; and third—ample protection is accorded the utility by means of advance payments, deposits and guarantees. While the lien clause, which in effect made every contract a mortgage on the consumer's lands, has been eliminated, it may be proper to draw attention to the fact that this clause has long since been voluntarily abandoned by practically every other electrical utility in California.

5. The criticism regarding rights of way is apparently based upon a misconception of the facts. I do not believe that the Journal would champion any system which denied service to a consumer unless he donated a perpetual right of way over his lands to the serving utility, not only to the point where the service is to be used but also to any and all points beyond.

While the railroad commission has completely revised the rules, regulations and contracts of each of these utilities, it is only justice to these utilities to say that their officials frankly admitted that these rules, regulations and contracts were largely a survival from conditions which have now passed, and that the revisions made by the railroad commission are fair and just.

Your editorial did not draw attention to the very large amount of gas engine agricultural pumping business located within the territory served by these utilities, which business the utilities were unable to secure because of their higher rates but of which a large portion will now be secured by them. The evidence showed that 22,000 horsepower of this business is located within one mile of the distributing lines of one of these utilities.

I am prompted particularly in writing this letter by the fact that unguarded and unfounded statements concerning "tremendous reductions in rates" must inevitably, unless corrected, act injuriously on the utilities affected in their future financing. These two utilities are doing a very necessary and praiseworthy service to the communities which they serve, and neither the railroad commission nor any one else who wants to see this state continue to develop and to see public utilities fairly treated, desires to inflict any unjust or unnecessary injury to them.

You will be interested to know that each of these utilities has filed the rates, rules, regulations and contracts prescribed by the railroad commission. The president and the treasurer of the utility most affected by the decisions have written to the commission expressing their appreciation of the commission's fairness during the hearings and in the decision—an unusual and much appreciated tribute—and stating their confidence in the result of the rates established. Both utilities are proceeding in good faith, under the rates established by the commission. The commission is satisfied that each of these utilities will find itself in a stronger position than under the old rates, which kept off a large amount of desirable business.

Thanking you in advance for the courtesy of publishing this letter, I remain

Yours truly,

MAX THELEN, President.

San Francisco, May 16, 1916.

[Mr. Thelen's authoritative interpretation of the commission's purpose in rendering this decision is seen to be entirely at variance with our own estimate of its probable effect. As time alone can give the answer, the subject cannot profitably be one for present decisive discussion. With due defensive deference, however, the only statement which Mr. Thelen cites as being "contrary to the facts," upon investigation, will be found true. The farmers in the San Joaquin Valley are jubilant over "the tremendous reduction in rate, the consumer may secure service without signing a contract," and experience has proven that the guarantees provided are inadequate to protect against dishonesty. Furthermore, difficulties in financing are due not so much to comment regarding decisions as to the apparent tenor of the decisions themselves.—The Editor.]

SALES VALUE OF ILLUMINATION.

At a recent meeting of the Louisville Gas & Electric Company, Emile Pilpel spoke on the sales value of good illumination. As an illustration he described approaching an old lady who ran a little shop on one of the streets out of the line of traffic where eggs and butter were sold. The shop was illuminated very dimly with carbon lamps. He spent some time trying to persuade the old lady to substitute large nitrogen lamps to replace the small carbon units, but was unable to convince her that the increased illumination would have sufficient sales value to justify the expenditure. Therefore he got her permission to try a little experiment. He placed one case of eggs on the sidewalk at one side of the entrance over which he hung a carbon lamp and put a sign over the eggs reading "Fresh Eggs—25c per Dozen." On the side of the door-way he placed another case of the same eggs over which he hung a bright nitrogen lamp and a sign reading "Fresh Laid Eggs—27c per Dozen." Then he stood in the background and watched the proceedings, and every one who came near walked over to the bright light and bought the eggs labeled "Fresh Laid Eggs" and paying for them at the rate of 27c per dozen. During the evening the old lady sold out that entire stock and none had been sold out of the other one. By this demonstration he convinced his customer of the sales value of illumination.

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Profit from the Junk Pile

A famous engineer visiting a great industrial plant, when asked what he particularly wished to see, replied "Your scrap pile." And in that waste heap he found so much of interest that he never went near the plant itself. He read the record of the plant in the quality of the material discarded.

Today many a scrap pile is being made a source of profit as well as of instruction because of the abnormally high prices of metals. In the course of wrecking the Panama-Pacific International Exposition, now well-nigh completed, the electrical department is disposing of much second-hand material at higher prices than were originally paid. In fact, regret has been expressed that copper conductors had been originally figured so closely, as the metal is today worth more than twice what was paid for it. A number of electric companies have also found it profitable to scrap aluminum transmission lines, substituting copper and even to replace copper distribution lines with iron wire, because of the high price the rarer metals command.

Another important result to be attained in keeping a close tab on the scrap pile is the checking of possible waste. One Western plant, which recently found it impossible to get better than six months' delivery on certain supplies, upon chance investigation of the scrap pile, found a quantity of material, which with slight modification was adapted to the required use and thus bridged what threatened to be a serious suspension of operations. As a consequence of this opportune discovery a careful inventory was made and a number of possible shortages forestalled. Hereafter, in this plant, accurate record is to be kept of everything consigned to the scrap heap.

Just as yesterday's progress depended upon the conversion of waste products into profitable by-products, so does today's depend upon intelligent utilization of the scrap pile.

Furthermore, it is a mistake to imagine that the only valuable junk is that which can be seen and touched. The caliber of an establishment can be judged as much by its discarded mental junk as by its physical scrap pile. The true measure of many a concern can be determined from the wornout ideas which have been abandoned.

In this respect a dump pile is valuable not so much from what can be salvaged as from what can be learned. There is usually some good reason for consigning anything to the limbo. Analyses usually shows that the reason is still subject to present justification.

Among the mental conceptions which scientific management tossed into the junk heap was the notion that the greater volume of output is to be gained by driving men and machines at top-notch speed. This idea is still obsolescent and in its place is found the rational thought that the real way to make speed is not to waste time.

Again, the reduction in rates for electric lighting has been due not so much to increased efficiency of equipment as to the discovery that a twelve or eighteen hours' use of current for other purposes makes three or four hours' illumination much cheaper. The idea of an exclusive lighting plant has been replaced by

that of a light and power plant. Today every effort is being strained to devise twenty-four hour uses, that work even while we sleep.

These examples are only typical of many that will suggest themselves to the reader who will refer to his experience, the scrap heap of mistakes made, but not repeated.

Dual Preparedness

Thousands of civilian engineers throughout the nation are spontaneously responding to the call for engineering preparedness as to defense. The engineer is the man for emergencies because his training and practice has tfited him to anticipate exigencies. The problems of modern military and naval defense are essentially engineering in character, and it is to the engineer that the nation looks in time of crisis.

As a class, there is none more patriotic than the engineer. This is exemplified not only by the loyal assistance being rendered the Naval Consulting Board in its inventory of industrial resources, but also by the earnest study of the principles of military engineering being conducted by many engineers. The survey of manufacturing and productive facilities is of even greater value to the army than to the navy. Knowledge of the rules and methods of warfare is equally indispensable to efficient operation.

Great interest is manifest in military lectures which have been given everywhere in America during the past few months. An engineering corps has been formed in nearly every great center of population. The members are enthusiastically taking up the study of organization and equipment for field maneuvers, investigating methods of offense and defense, mapping, searchlight operation and camp sanitation.

But all of this is only a small beginning. It is only paper warfare. The statistics of manufacturing and producing facilities will be useless unless these facilities are made possible of immediate availment. Every factory should be supplied with blue prints and dies so that machine tools could be instantly put to making implements of warfare instead of implements of industry. Every machinist should know how to make war munitions. Every railroad should be ready for quick conversion into a means for the rapid handling of men and supplies. The mobilization of supplies is fully as important as the mobilization of men and for every man in the field there is necessary another man at the bench.

No factor has added more to America's capabilities of defense than the local manufacture of munitions for the European belligerents. While working for Europe today they are also working for the America of tomorrow. Such enterprise should be encouraged rather than retarded by the proposed waste of eleven million dollars to build a government armor plant, when existing private plants have demonstrated that they can make armor cheaper than the government can do for itself.

The same thought applies to the proposal that the government build an air nitrate factory when private capital is available for this purpose. In times of peace these nitrates are available for fertilizers, in time of war for explosives. Whereas, the Smith amendment to the Chamberlain bill provides for an appropriation of eleven million dollars for one government owned plant, there is fully one hundred million dollars in private capital available to build nitrate plants if congress will only pass laws permitting the development of unused water powers.

This governmental restriction of water power development brings to mind one phase of preparedness which is apt to be overlooked,—preparedness for peace. It has been repeatedly prophesied that the war will stop as suddenly as it started. Already the faint light of the dawning day of peace is paling the lurid lights of war. The end of military and naval warfare will mark the beginning of industrial competition among the nations.

And American business men are as unready for peace as the American nation was unprepared for war. The "red" in readiness is ever of a paler pink than the red in a preparedness. Instead of being wideawake to peace probabilities, business men are dreaming of war possibilities. Now is the time to mobilize resources for a campaign of trade extension, not only abroad, but at home. The dislocations caused by war will make necessary new adjustments in time of peace.

Therefore let us be alert to both sorts of preparedness. By all means attend one of the military training camps, if possible, but realize that this one month's preparedness for possible war is only incidental to eleven months' readiness for probable peace. The Industrial Trade Commission's survey of the commercial situation is of more lasting benefit than the Naval Consulting Board's inventory of industrial conditions. Familiarity with the rules and methods of business are more indispensable to prosperity than knowledge of those of warfare.

The Selling Problem

Many managers of small electric light and power companies are overlooking an opportunity for greater sales of their service by not adapting and adopting the sales methods of the large central stations and manufacturing companies. The selling problem has superseded most of the technical difficulties that once beset plant operation. It is not so much the engineering of materials as the engineering of people that concern electric plant progress.

Scientific sales management has established a standard of expectancy as to business in each district. A certain quota is set for each salesman. His method of approach, display and closing is individually watched and suggestions made as to improvement. Some form of incentive, over and above straight salary is provided to encourage the best efforts on the part of each salesman so that he may surpass his quota. In addition, the work of the credit department is co-ordinated with that of the selling department so that the salesman will be advised as to the terms upon which desirable business will be accepted, thus doing away with hard feelings on the part of declined prospects. These principles are as applicable to selling electric service as to selling electric apparatus simply because they embody the issues of all true salesmanship,—service.

PERSONALS

W. P. Naser, Pacific Coast manager Trumbull Manufacturing Company, is at Los Angeles.

E. N. Brown of the Majestic Electric Company, has returned to San Francisco from New York.

C. A. Malone, purchasing agent California-Oregon Power Company, has moved his headquarters to San Francisco.

C. G. A. Baker, vice-president and treasurer Baker-Joslyn Company, has returned from a business trip to Los Angeles.

Paul A. Shilton, representing R. J. Davis, agent for Century motors and fans, has been visiting the cities of Southern California.

Caxton Brown, general manager of the Weston Instrument Company, is expected to visit the Pacific Coast in the very near future.

F. J. Cram, sales manager, Electric Appliance Company of San Francisco, is making a two weeks' trip through Oregon and Washington.

Wm. von Phul of the American Cities Companies, will assume the management of the United Railroads of San Francisco on June 1, 1916.

Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company, has been on an auto trip throughout the Sacramento Valley.

H. M. Byllesby, president H. M. Byllesby & Co., and **O. E. Osthoff,** vice-president, are inspecting the company's Pacific Coast properties.

S. P. Russell, manager electrical department H. W. Johns-Manville Company, has returned to San Francisco from a business trip to Los Angeles.

A. S. Armstrong, local manager for R. J. Davis, agent for Century single phase motors, has been visiting the towns in Napa and Sacramento Valleys.

Squire V. Mooney, Pacific Coast manager of John A. Roeblings Sons Company, has returned to San Francisco from a month's trip in the Northwest.

G. H. Bradt, vice-president of the Wizard Electric Lamp Company, San Francisco, has returned from a trip to New York, and is now at Los Angeles.

Ira J. Wolfe, Pittsburg Electric Specialties Company, has returned to San Francisco from a short business trip in his auto from northeastern California.

Reginald Duden, formerly with the Pacific Motor Company, is now traveling in Northern California for R. J. Davis, representing Century motors and fans.

T. E. Bibbins, local manager of the General Electric Company at San Francisco, left this week to attend the National Electric Light Association convention at Chicago.

F. E. Boyd, in charge of the small motor department of the General Electric Company at San Francisco, is recovering nicely from an operation for appendicitis.

J. A. Vandegrift, manager of the Oakland Lamps Works of the General Electric Company, has returned to Oakland, Cal., from an extended trip throughout the East.

E. D. Pike, of the Wagner Electric Manufacturing Company, has been appointed manager of service stations at Portland, Seattle, Los Angeles, Salt Lake and San Francisco.

F. H. Leggett, Pacific Coast manager Western Electric Company, and **Gerard Swope,** vice-president and general sales manager, are making a trip to Seattle and other northern cities.

W. H. Lines of the Portland Railway, Light & Power Company, has gone to Chicago to attend the N. E. L. A. Convention. Mr. Lines will also extend his trip to several Eastern cities.

L. R. Jorgensen, consulting electric and hydraulic engineer at San Francisco, has resumed his work of supervising the construction of two large dams on Rush Creek, in Mono county, California.

Frank E. Smith, Weston Instrument Company, has returned to San Francisco from a two weeks' auto trip mixed with pleasure and business, throughout the northern and central parts of California.

O. E. Thomas, 626 Washington Building, Los Angeles, has been appointed district sales manager for The Terry Steam Turbine Company for Arizona and the southern portions of California and Nevada.

J. R. Wilson, formerly sales manager and vice-president of the Crocker-Wheeler Company of Ampere, N. J., has become associated with the Davison Chemical Corporation of Baltimore, Md., as manager of their office at New York.

S. B. Anderson, of the Pacific States Electric Company, has been spending some time at the branches. During the past three weeks he has been at Seattle and Portland and during the present week is at Los Angeles. He is expected to return to his desk at San Francisco on Monday.

W. A. Blair, who has been with the Pacific States Electric Company almost since its formation, has resigned as secretary and treasurer in order to engage in business on his own account. The financial end, including the credit department, will be under the supervision of **S. B. Anderson,** with the title of treasurer.

C. H. Carter, who has been in charge of the Los Angeles branch of the Pacific States Electric Company as district manager, has been transferred to the head office, and will devote much of his time to stocks and numerous propositions particularly affecting the branches. At Los Angeles, **F. J. Airey,** in addition to his duties as sales manager, will direct the affairs of that branch.

MEETING NOTICES.

Oregon Electrical Contractors' Association.

The regular monthly meeting was held in the auditorium of the Electric Building, the evening of May 6th. The paper of the evening was read by Mr. Paul C. Bates on the question of "Compensation."

San Francisco Engineers' Club.

Dr. W. W. Campbell, director of the Lick Observatory gave a popular talk on "The Stellar System" at a mid-day lunch on May 11th. The main point developed that whereas until about a generation ago most astronomical research had been directed to a study of our solar system, recently, improved equipment has made possible a study of the entire stellar system in which our own system is moving at a rate of 12¼ miles per second.

Oakland Jovian Smoker.

Nearly two hundred electrical men from the San Francisco Bay region attended a Jovian smoker given in the Commercial Club, Hotel Oakland, May 12th. Tribunes Woodward and Hill had arranged an interesting program of speeches, stories, songs, dances and music, interspersed with moving pictures. Announcement was made by Tribunes Orrick and Wilcox that a joint rejuvenation of San Farncisco and Oakland Jovians would be held on June 10th.

the assembly, was the guest of honor at the luncheon on May 10th. A. E. Morphy, vice-president of the league, occupied the chair, and J. W. Thompson, as chairman of the day,

Los Angeles Jovian League.

Alfred L. Bartlett, a prominent attorney and member of had charge of the program. Mr. Bartlett explained the operations of the legislature at Sacramento, in a speech entitled, "Machinery of the Law," interspersing his talk with a number of humorous stories and incidents. In concluding, he

criticized some of the appropriations made by the 1915 legislature in the face of an existing deficit of over $2,000,000, and stated that as the burden of taxation becomes greater, the public is growing tired of political denunciators, and is demanding constructive statesmanship, and representatives with a zeal for firmness and efficiency of government. The "Rogan Cup," presented to the League by Jas. F. Rogan, Pacific Coast agent, Edison Storage Battery Company, was awarded to C. B. Hall, secretary and treasurer of the Illinois Electric Company. This cup is presented to the chairman of the day "putting over" the best meeting over a period of six months, and the competition was extremely keen, Mr. Hall winning by a slight margin. While some of the programs proved more interesting from the standpoint of entertaining features, the award was made for the best balanced program, on the basis of the following percentages: Attendance 25 per cent, education 40 per cent, speaker 20 per cent and entertainment 15 per cent. It is interesting to note that the Jovian singers furnished the entertainment at this luncheon.

San Francisco Electrical Development and Jovian League.

With W. W. Briggs, general agent Great Western Power Company, in active charge of the May 10th meeting, it was one of the most successful and largely attended of President Cutting's administration. The principal address was made by Max Thelen, president of the California Railroad Commission, who took as his subject "Theory and Practice of Public Utility Regulation in California." After defining the various classes of utilities coming under the commission's jurisdiction he outlined the powers of the commission. The work of the commission, as contrasted with the courts, is characterized by dispatch. Since January 1, 1911, only 22 decisions have been appealed to the courts, and all but three of these were sustained. Since 1913 the commission has won all of the 17 appeals from its rulings. Mr. Thelen characterized the recent San Joaquin and Mt. Whitney rate decisions as the most important yet rendered. He thinks that the lower rates prescribed will make it possible for electric motor pumping to supersede many gas engine installations and hopes that they will ultimately benefit. He mentioned the case of the San Jose Water Company, the expiration of whose corporative life was cared for by transferring all property to a new corporation with the proviso that the new company make no claim for franchise value inasmuch as the franchise cost nothing. He gave warning that if capitalization of franchises were insisted upon, the public would refuse to grant them and arrange to perform the services themselves. He told how, in the case of the San Diego & Southeastern Railway whose past losses in connection with recent floods, made continuance of service difficult, the commission's experts had suggested savings in operating expenses so that it would be possible to resume work. These savings were due primarily to the substitution of street railway operation for interurban cars. He announced that hereafter the commission would supervise and inspect all public utility dams and also provide for the safety of electrical workers by a system of accident reports and prevention. In conclusion he stated that it was the aim of the commission to protect the public and at the same time provide incentive for public utilities to make extensions. Mr. Thelen's remarks were heartily applauded and a rising vote of thanks extended to him and to Mr. Briggs.

California Section of the National Association of Electrical Inspectors.

The regular monthly meeting of the association was held at Stockton, Saturday, May 6, 1916. The question of electric ranges was discussed as there appears to be misunderstanding in sections of the state as to what switch complies with Section 25 of the National Electric Code. These ranges are usually provided with three-heat single pole switches and some have the units individually fused. Ranges of this character are at times installed without other protection on the assumption that these fuses and switches are the ones referred to in the Code. The Code treats ranges as a complete unit and requires that switch and cut-outs be provided to disconnect and protect all wires of the circuit feeding the range, the switch to be located within sight of the heater.

The question of ground clamps was discussed in detail, several members contending that certain ground clamps used in this territory do not in the smaller sizes properly accommodate No. 6 B. and G. wire, now required on conduit containing service wires. It was the general understanding that overload release devices on starting compensators for a.c. motors do not comply with the requirements of Section 8 (c) of the Code which requires cut-outs for this purpose.

The next meeting of the Association will be held June 3d at Berkeley at which the subject of concentric wiring will be discussed. Samples of this wire and fittings have been received so that an interesting meeting is looked forward to. The departments represented at the last meeting included Stockton, Modesto, Richmond, Sacramento, San Francisco, Berkeley, and the Board of Fire Underwriters.

Utah Electric Club.

At the regular meeting at the Newhouse Hotel, Thursday, May 11, Mr. Lafayette Hanchett, a director of the National Copper Bank of Salt Lake City, addressed the members on the subject "The Fixation of Nitrogen from the Air by Electricity." Mr. Hanchett reviewed briefly the history of the development of this process and described the principal processes in use. He quoted figures showing the amount of power now applied in this industry and brought out the rather surprising fact that only 0.8 per cent of the total power utilized for this purpose is in the United States. The thing which Mr. Hanchett most strongly emphasized was the fact that this country might find itself in a shocking state of unpreparedness, so far as the supply of raw materials, in case it were forced into war with any world power. Our supply of nitrates for manufacturing powder must then be secured from Chili and if our opponent could effectually close this trade route we would find ourselves in a serious situation. Furthermore, that investigation shows, that the production of nitric acid from the air is commercially feasible wherever electric power is available at a rate of $9 per h.p. per year. That this figure is not likely to prove attractive to private capital in the development of large water powers for this purpose, due principally to the general availability of a higher priced market, he considers it important that the government undertake the development of unused water powers for this purpose. Mr. Hanchett urged all the members of the club to study the subject so that they could talk intelligently on it and interest others so that eventually such a strong sentiment be created in favor of the movement, that the government would be lead to take it up. Mr. Hanchett pointed out that ordinarily he was opposed to the government engaging in such enterprises as are likely to be developed by private initiative, but that he felt that in this case an exception should be made. Mr. Hanchett suggested that the club present a memorial to its representatives in congress urging them to lend their support to such a project. President Armstrong appointed Mr. Hanchett, Mr. B. W. Mendenhall and H. T. Plumb to prepare the memorial.

Portland Sections of A. I. E. E. and N. E. L. A..

At the meeting on Tuesday evening, May 9th, Laul Lebenbaum, presided as chairman and the speakers of the evening were W. H. Lines, Portland Railway, Light & Power Company, who gave a talk on "The Electrical Installation of the Western Cooperage Company," in Portland, Oregon, and E. F. Whitney of the General Electric Company, who talked on "The General Application of Electricity to the Logging Industry."

O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, and who has been appointed a state director of the organization for industrial preparedness, also outlined the plans for carrying on the work in Oregon. J. B. Fisken, Washington Water Power Company, was called upon for a few general remarks. Mr. Lines said in part, that the plant is in a general cooperage business. Only about 30 per cent of the timber is manufactured in cooperage products and 70 per cent is waste. Nevertheless the company is selling the greater part of it and buying approximately electric power for 1500 h.p. of motors connected load. The ways that the waste is disposed of includes fuel for steam dry kilns, fuel sold to a wood company for domestic use, chips for paper mill use, ground up fuel for other industrial purposes. The electric motors are direct connected and used for group drive. The company keeps complete figures on costs and uses a graphic ammeter on their switchboard to check up the various mechanical departments. By experience they have found that a certain current is necessary to run each of them at its highest efficiency, and if the current increases and the output does not do so at the proper rate an investigation is made. This is a great "boost" for electric drive as they could not do this with steam.

Mr. Whitney said in part, that the first logging engines using electric motor drive were used by the Potlatch Lumber Company in Idaho. They were equipped with standard I. T. Z. 150 h.p. Generel Electric motors without any special design. They have been satisfactory and have a greater output to their record than the steam logging engines, the ratio being 47,000 feet per day for steam and 62,000 ft. for electric. They also operate more safely during dry season and longer when the cold weather comes on, as they are not such a fire hazard and no water to freeze in winter. It took about 400 kw.-hr. per engine per 52,000 feet per day. Also the C. A. Smith Lumber Company, Marshfield, tried out Westinghouse equipment on some logging engines and were highly pleased. If financial difficulties had not arisen they would have placed a contract for 26 of them. Mr. Lebenbaum could not accept the delegateship for the section to the A. I. E. E. National Convention and Mr. Merwin, superintendent Northwestern Electric Company, was elected to attend. The following committee was appointed to nominate officers for the ensuing year for the local section of the N. E. L. A.: Messrs. Moody, Fear, Bowen, Osborne, Wakeman.

Extraordinary National Institute Meeting.

The most notable national meeting ever conducted by any organization was that held on May 16th by the American Institute of Electrical Engineers, with 6000 members in eight cities participating over the telephone. Promptly at 8:30 p. m., Eastern time, President J. J. Carty called the meeting to order as an adjourned session of the regular annual meeting. Responding to roll-call were Atlanta, with 550 present; San Francisco, with 750; Boston, with 500; Philadelphia, with 650; Chicago, with 1000, and New York, with 1100. Denver and Salt Lake also listened in, but did not talk.

President Carty then extended greetings to the membership, and read President Wilson's message on the subject of the meeting. Announcement was made of new officers elected, and President-elect H. W. Buck introduced, as were likewise Dr. Alexander Graham Bell, Theo. N. Vail, a representative of the British association, and Thomas A. Watson, all of whose remarks were heard distinctly throughout the entire system.

Brief recess was then taken, as far as the transcontinental proceedings were concerned, so that members could listen to addresses by noted speakers at each city. At San Francisco Dr. Ray Lyman Wilbur, president of Stanford University, read an address concerning electricity's contribution to human welfare, with specific reference to the telephone, automobile, electric light, electric railway, phonograph and electric motor.

In resuming telephonic proceedings, greetings were extended from the several sections, John A. Britton speaking at San Francisco, and then phonograph music was played at each city, so that it could be heard throughout the country. Dr. M. I. Pupin then gave a masterly address on engineering as the noblest of arts, and Ralph W. Pope sent words of greeting. On motion by Professor Harris J. Ryan, the proceedings of the meeting were ordered spread on the minutes, and then was brought to a successful close the most remarkable meeting ever held, six cities simultaneously participating.

The local arrangements at San Francisco were in charge of A. H. Babcock, chairman of the section, who presided at the meeting and talked over the transcontinental line, using a special, sensitive transmitter. Each chair in Native Sons' Hall was equipped with individual receivers, so that the full proceedings were heard by all present.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION.

The California Electric Railway Association has been organized to facilitate concerted action on franchise and paving questions, to foster a better understanding between the public and the electric railways, to promote co-operation among the railways themselves, to collect and distribute data of value to the railways, and to secure proper regulation of auto competition. G. K. Weeks, president of the San Francisco-Oakland Terminal Railways, Oakland, is president of the association; William Clayton, vice-president and managing director of the San Diego Electric Railway, is vice-president; and W. V. Hill, tax and contract agent of the Pacific Electric Railway, Los Angeles, is manager, with offices in San Francisco. The directors of the association are Mr. Weeks, the president; Mr. Clayton, the vice-president; Paul Shoup, president of the Pacific Electric Company; W. E. Dunn, vice-president of the Los Angeles Railway Corporation, and Jesse W. Lilienthal, president of the United Railroads, San Francisco. Mr. Hill will have a secretary to attend to office matters so his time can be given to paramount issues. Every electric railroad in California is represented, including the electrified steam lines.

NEWS OF IDAHO PUBLIC SERVICE COMMISSION.

James R. Wheeler has been granted a certificate of necessity and convenience to construct an electric light and power system in the towns of Carey and Picalo, Blaine county, Idaho.

At the request of the applicant, the commission has dismissed the application of H. L. Thomas for a certificate of convenience and necessity to construct an electric light and power plant at Lava Hot Springs, Bannock County, Idaho.

NEW CATALOGUES.

The Ward Leonard Electric Company of Bronxville, New York, has issued a new section to be added to their loose leaf catalogue. This is section G-13, which covers their adaptor (plug and socket) resistance units.

"How to Design Effective Lighting" is the subject of No. 6 in the series of salesmen's lamp handbook series being issued by the Westinghouse Lamp Company. Valuable suggestions are given on the artistic lighting of stores and residences.

"The Gateway of Electric Service" is the title of a neat pamphlet published by Pass & Seymour, Inc., wherein electricity is traced from its point of generation to the lighting fixtures, an important part of which is the socket, types of which, as manufactured by this company, are illustrated and described.

NEWS NOTES

INCORPORATIONS.

RIVERSIDE, CAL.—The Riverside County Gas & Power Company has filed articles of incorporation, with principal place of business at Beaumont. The capital stock is $100,000. The directors are Nathan W. Tarr of Sierra Madre, Henry W. Burkhart of Los Angeles, Frederick N. Hawes of Monrovia, Kenneth R. Smoot of Beaumont and De Roy H. Gates of Banning.

SALEM, ORE.—To promote industrial waterpower development for electrical energy for the production of atmospheric nitrogen and its fixation with lime and other minerals and organic materials, and for the production and manufacture of acids, the Deschutes Hydroelectric Process Company, with headquarters in Portland, has been organized. The company is capitalized at $350,000. The incorporators are John A. Jeffrey, C. D. Charles and E. Z. Ferguson of Portland.

ILLUMINATION.

FLORENCE, ARIZ.—All bids received by the city council for water and light bonds have been rejected.

DINUBA, CAL.—The River Bend Gas & Water Company of Parlier is extending its gas mains from Parlier to Kingsburg.

LOS ANGELES, CAL.—The board of public service commission will receive sealed bids for incandescent lamps up to May 23d.

IDAHO FALLS, DAHO.—D. T. Murphy has been looking over the field at Dubois with a view to establishing a light and water plant.

OAKLAND, CAL.—Sealed bids will be received by the city clerk up to June 1st for 24 lighting posts to be constructed on Grove street.

LOS ANGELES, CAL.—The report of the lighting committee of the Van Nuys lighting district, submitting demand for work, has been approved by the board of supervisors.

REPUBLIC, WASH.—The Laurier Mining Company has applied to the commissioners of Ferry county for a franchise to construct light and power lines on the public roads of the county.

SANTA BARBARA, CAL.—The city council has given permission for the placing of a sample concrete lighting post here, that citizens may have the opportunity to inspect it. The company offers to install light posts at $18 each.

TURLOCK, CAL.—The city council has under advisement an offer of the Yosemite Power Company to reduce rates on street lighting and power for the city water works amounting to $1600 a year if the board will make no effort to disturb domestic rates for light and power.

LOS ANGELES, CAL.—The first move toward installing arc lights using aqueduct power has been made by the city electrician. In a petition to the council the electrician asks that provision be made for the installation of some 800 lights on the East Side where a municipal power distributing plant is now being installed.

TRANSMISSION.

TAFT, CAL.—The San Joaquin Light & Power Company is installing two miles of pole line to connect power with the Nacirema lease in the McKittrick field.

OAKDALE, CAL.—The Oakdale irrigation district proposed to establish a large power plant in the mountains in connection with its storage system.

LOS ANGELES, CAL.—The offer of the power companies operating here to buy all the city aqueduct power for $750,000 per annum has been rejected by the city council.

OROVILLE, WASH.—The Okanogan Power Company has acquired the holdings of the Similakameen Power Company and is extending the system to Mansfield and other near-by points.

OAKLAND, CAL.—The annual report of the Great Western Power Company announces that the company contemplates erecting a second tower line from the Feather River plant to Oakland as well as a second power house on the Feather River.

RIVERSIDE, CAL.—Negotiations have been concluded between the Southern Sierras Power Company and the Tungsten Mines Company, whereby the power requirements of the latter company in the operation of its mines and mills near Bishop, will be supplied from the lines of the Sierras Company.

PORTLAND, ORE.—The Pacific Power & Light Company announces that the sum of $260,000 will be expended this summer in the state of Washington in new improvement work, the largest expenditure being the installation of a concrete substation to cost $75,000 at North Yakima, Wash. A 22,000 volt transmission line is also to be built from Warrenton to Seaside, a distance of nine miles, at a cost of $22,000.

CARRIZOZO, N. M.—The Alto Light & Power Company, with headquarters at White Oaks, has disposed of its holdings, including a coal mine on which was a power plant that furnished power to the mine and mills as well as light for the town and two transmission lines for power and light. The transfer will take place on July 1st. J. H. Fulmer, Jr., president of Parsons Milling Company, and associates are the purchasers and the company will continue to operate under the original corporation title.

TELEPHONE AND TELEGRAPH.

NAPA, CAL.—Stanley M. Long and others have been granted a temporary permit to erect a telephone line in the Lodi Road District.

FOWLER, CAL.—Lack of a quorum prevented the annual meeting of the Fowler Independent Telephone Company doing other business than to receive the annual reports. The present board of directors will hold over for another year.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The San Francisco - Oakland Terminal Railways proposes to buy 36 new cars, including 20 steel cars of the pay-as-you-enter type. The cost is estimated at $234,000.

MARTINEZ, CAL.—The board of trustees refused to open bids on the franchise requested by the Martinez-Concord Interurban Railway Company as the result of protests received by residents.

FLAGSTAFF, ARIZ.—Rumors are in circulation that Los Angeles and Phoenix capitalists back of the Phoenix Street Railway Company, contemplate building an electric interurban railway from Flagstaff to Grand Canyon.

STOCKTON, CAL.—The city council has passed an ordinance granting the Tidewater & Southern Railway Company authority to electrify certain portions of the railroad tracks of the Western Pacific Railway Company.

ALAMEDA, CAL.—Councilman J. H. Wilkins is endeavoring to have the San Francisco & Oakland Terminal Railways install a spur track from Santa Clara avenue to Central avenue, on Webster street, and thus give direct service from Oakland to the beaches.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co.. Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co..... 673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 2
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co..... 590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 4
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 12
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... 3
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 11
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-7 Economy Fuse & Mfg. Co..... Kinzie and Orleans Sts., Chicago.

E-1 Edison Lamp Works of General Electric Co..... Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co..... 247 Minna Street, San Francisco; Central Building, Los Angeles.

E-6 Electric Novelty Works..... 532 Mission St., San Francisco.

E-4 Electric Storage Battery Co..... 743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 11
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric)..... 618 Mission St., San Francisco.

G-1 General Electric Co..... 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co..... 1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Wire Co..... 12
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 Hunt, Mirk & Co..... 111 Second St., San Francisco.

H-7 Hurley Machine Co..... New York and Chicago. (See Pacific States Electric Co.

I-2 Illinois Electric Co..... 261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co..... 3
111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... Sunnyvale, Cal.

M-4 Morse Chain Company..... Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N..... 151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... 4
Cleveland, Ohio.

N-2 National Conduit & Cable Co., The..... Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... (All Jobbers.)

N-4 New York Insulated Wire Co..... 629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad..... 3
808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 12
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co..... 80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 4
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-6 Pittsburgh Electric Specialties Company..... 202 Aronson Bldg., San Francisco.

P-7 Pittsburgh Piping & Equipment Co..... 12
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The..... 211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 2
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 3
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co..... 3
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R..... Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company..... Pawtucket, R I.

U-1 Union Sheet Metal Works..... 575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company..... 3
St. Louis, Mo.

W-2 Western Electric Co..... Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 Westinghouse Electric and Manufacturing Co..... 5-6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co..... 141 Second St., San Francisco.

W-6 Westinghouse Lamp Co..... (See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co..... 444 Market St., San Francisco; 1758 North Broadway, Los Angeles.